Lesson 3 We Recycle!

Objective: Students will learn about the benefits of recycling as they apply math and science skills to learning about recycling in their communities.

Subject Areas: Mathematics, Earth Science

Materials: Paper and markers Chart paper Trash School personnel (including maintenance person, art teacher, cafeteria workers) Garbage bag filled with paper garbage A scale Rubber gloves (4-5 pairs) Time: This lesson may need to be done over two class periods.

Procedures: Before: Whole Group Instruction 1. Building Background: Waste production and waste management are a part of everyone’s lives. Your students already know a lot about making, and getting rid of, their garbage. Talk about their waste management habits to get them thinking about the subject of garbage.

Whole Group Discussion

Questions: Ask students about what kinds of garbage they produce at home. What types of garbage do they produce in the classroom? What are some of the differences? Record their answers on a sheet of chart paper labeled, “Types of Garbage.”

Ask students who recycles at home. (Some cities have recycling laws in place and most students will respond that they do recycle at least minimally, at home.) What kinds of waste do they typically recycle? Ask students to estimate about how much garbage they personally create each day. About how much garbage do they think they produce as a family at home? Some statistics indicate that the average person in the United States produces about five pounds of garbage each day.

Before the lesson begins, collect a garbage bag full of paper garbage. You want a bag that weighs about five pounds. Hold up the bag and tell students what the bag weighs. This will allow them to estimate the weight of the garbage they produce. Remind them that if a bag this size had food or other, heavier garbage inside, it might weigh as much as twice the amount of paper garbage.

Ask students what they think are some of the benefits of recycling. (Possible answers include less garbage for landfills, less garbage incinerated, reclamation of expensive and hard-to-find resources such as metals and glass.) Why do cities have recycling programs? What would happen to garbage if it wasn’t recycled? (Possible answers include incinerators, landfills, dumping in water systems.) List their responses on a separate sheet of chart paper labeled, “Recycling Benefits.” You will go back to this list at the end of the lesson.

During Small Group Work: 2. Divide the class into groups. Each group is responsible for a different garbage “set.” Assign one group to the classroom garbage. Assign another group to garbage produced by a specialty subject, such as Art class. Assign another group to the cafeteria. Assign a final group to the school office (if this is not available to you, try another administrative area of the school). Each group is given a pair of rubber gloves and an empty trash bag.

3. Send each group to their areas or classrooms (having prearranged ahead of time, so that students will show up in the classrooms at this time). Once there, each group, neatly and without making a mess, empties the garbage cans from that classroom into one garbage bag. This should be done wearing rubber gloves. Each group should aim to collect one medium-size bag of garbage weighing about 5-10 pounds. Students assigned to the cafeteria might want to take the garbage from just one of the trashcans, so they don’t end up with too much garbage.

4. Back in your classroom, arrange student desks as worktables — one for each group. When students are finished collecting their trash, have them return to the classroom and bring their garbage bag to their work station. Have students cover their tables with old newspaper (you may want to tape this down to the tables). Before students empty out their trash bags, have them estimate the weight of their trash. If you have a scale available, they can weigh their bags and record the weight on their sheets. Now ask students to neatly empty their bags onto their work stations

5. Using rubber gloves, have students sort through the trash. Groups work together to create trash categories. It will be up to them to choose the size of their categories. They might create categories such as paper, metal, glass, etc. Or, they may want to make more specific categories such as construction paper, computer paper, loose leaf paper, etc.

6. Ask students to assign one member of the group to graph their information. Hand out Worksheet #4 Recycling Graph. Instruct the “grapher” in each group to make a tally of the total number of pieces of garbage under each category. If they decided to divide their trash into more specific categories, they can show that on the graph as well. For instance, under the category, FOOD WASTE, in addition to recording the total number of pieces of food waste, students may also wish to record the number of apple cores versus banana peels. After: Sharing Results

7. When groups have completed their graphic exercise, ask them to report their results back to the class. On a piece of chart paper, create a table. List the garbage categories across the top of the chart (x axis). On the left column of the chart (y axis), list the name of each group (classroom, Art room, cafeteria, etc). Ask each group to report their specific tallies for each category, and record the numbers by the group name. You can also list the specific types of garbage in each category if students have provided this information.

8. When you are finished recording the information on the chart paper, discuss your results with the class. What were the differences that your students noticed between the different classroom areas? What do they think about the overall amount of waste in each classroom? Was most of the garbage necessary or did some of the items not need to become garbage? How much of the school garbage do they think they are personally responsible for? Is there anything they can do to reduce that amount? How does the garbage produced at school compare to the garbage produced at home? Are there different types of garbage produced at home and school? What about the overall amount?

9. What do students think happens to the garbage once it is in the wastebaskets? Have each student write down at least one question about what happens to the garbage they produce at school. Ask them to volunteer their questions and list the on the board. 10. Invite the maintenance worker into your classroom. Ask this person the questions from the list the class generated (you may wish to invite your students to conduct the interview using their individual questions). Have them take notes about the answers. They will use these notes to complete the Extension Activity, if

Assessment: Use class participation and the graphs to assess the students’ work. The following rubric can help guide your assessment.

Basic Understanding Proficient Understanding Advanced Understanding

Participated in Class Discussion Provided minimal ideas during group discussion, or contributed ideas that were not relevant to the discussion

Actively participated in group discussions with ideas that were on topic Actively participated in group discussion with unique ideas that furthered the conversation Understood the Benefits of Recycling Demonstrated limited understanding of recycling Demonstrated understanding of the recycling including some benefits Demonstrated deep understanding of the problems with waste management, and why recycling was a potential solution Categorized Types of Garbage

Was not able to create categories from the garbage collected Identified different categories and was able to place most of the garbage into correct categories Identified different categories, placed the objects in the appropriate categories and created new and more detailed category headings

Created a Graph from Collected Information Included information, but did not put this in graph form Used the information to create a bar graph Used the information to create a bar graph, added additional features or ideas to communicate additional information

Extension Activities: I. Visit to a Facility: Find out where the waste processing facility is in your community. Have students find the facility on a map, and then map the distance between the school and the plant. What is the route that the school garbage takes to get to the processing plant? Is it close enough for a visit? If so, visit the waste processing facility on a class trip. Ask students to take notes about what they find out. How does what they learn affect their recycling behavior? II. Research Paper: Have students do a research project about the benefits and challenges of recycling. Students can choose from a variety of hypothesis statements. Some possibilities are: • Recycling is beneficial to the environment. • Composting organic waste is beneficial to the environment. • Choosing items with less packaging will reduce overall garbage production. • Dumping waste in landfills is a potential environmental problem. Some materials are more difficult and therefore costlier to recycle. Other materials cannot be recycled by the available facilities in a community. Trucking those materials to a different community uses energy and causes pollution. Some items are made of multiple materials, and therefore cannot be easily recycled. Students’ research should focus on understanding the challenges of recycling and also learning more about the benefits. Once they settle on their hypothesis statement, their research should be focused on proving or disproving that thesis. They can use the links provided in the Additional Resources section of this packet to help guide their research. \*III. Calculating the Amount of Garbage Produced: It is estimated that each person generates approximately 5 pounds of garbage each day. Further, it’s estimated that more than 75 percent of that garbage could be recycled, but only about 1 percent is, in most communities (the communities that even recycle as much as 30 percent are the ones that have recycling programs set up). Further, the average cost of dealing with garbage is about $40 per ton of garbage. However, if this garbage was recycled, rather than paying money to have the garbage collected, the city would get money back from selling back the recycled materials. Students can use a number of $10 per ton to estimate the average payment the city would receive for depositing their recycled materials. Using the numbers above, first ask students if they think 5 pounds a day per person is a realistic number. Using the number that they think is correct, have students estimate the amount of waste generated by their community in one month. They can use the school community, their neighborhood, or their city as the multiplier. Now have them do the math. (Remember, 1 ton equals 2,000 pounds).

A Sample Calculation: As an example, let’s work with the numbers of 1,000 students in the school community, each producing 5 pounds of garbage a day. The 1,000 people in the school each produce 5 pounds of garbage a day. 1,000 x 5 = 5,000 If 5,000 pounds of garbage are produced each day, how much garbage is produced in one month? 5,000 x 30 = 150,000 pounds. There is 2,000 pounds in each ton, so how many tons equal 150,000 pounds? 150,000 / 2,000 = 75 tons of garbage per month. If it costs, on average, $40 per ton to “throw away” garbage, how much would it cost to throw away the school’s garbage each month? 75 tons x 40 dollars/ton = $3,000 per month. If instead, 50% of that garbage were recycled, there would be 50% of the 75 tons to recycle. 75 tons / 50% = 37.5 tons of garbage. If the city were to be paid at $10 per ton for the recycled garbage, how much money would they get? 37.5 tons x $10 per ton = $375. There would also be only half as much garbage to pay for, or 3,000 / 50% = 1,500 dollars to throw away the garbage. So, rather than spending 3,000 dollars a month to throw away all the garbage produced by the 1,000 students in a school in one month, the city would spend only 1,500 dollars and would get back an additional 375 dollar. This would mean they were spending about 1,125 dollars a month, instead of 3,000 on waste management. Now have students use Worksheet #5 Garbage Math to do their own calculations.

Lesson Three: We Recycle! Garbage Math What is the community you will be analyzing? Write it here. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ How many people are in that community? Write it here. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Assume that each person in your community produces 5 pounds of garbage per day. Multiply the number of people in your community with the amount of garbage they produce each day. \_\_\_\_\_\_\_\_\_\_\_\_\_ (number of people) X 5 = \_\_\_\_\_\_\_ pounds of garbage each day Multiply that number with 30 to get the pounds of garbage produced in one month. \_\_\_\_\_\_\_\_\_\_ pounds x 30 days = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ pounds Now divide the number of pounds by 2,000 to find out how many tons are produced. \_\_\_\_\_\_\_ pounds / 2,000 = \_\_\_\_\_\_\_\_tons of garbage per month It costs the city, on average, 40 dollars per ton to “throw away” their garbage. How much does the city spend throwing away the garbage from your community? \_\_\_\_\_\_\_\_ tons of garbage per month X $40 per ton = \_$\_\_\_\_\_\_\_\_\_\_. THIS IS THE COST OF HANDLING THE COMMUNITY’S GARBAGE, WITHOUT RECYCLING. Now divide the number of tons of garbage per month by 50% (or in half) to find out how much of the garbage could be recycled. \_\_\_\_\_\_\_\_ tons of garbage / 50% = \_\_\_\_\_\_\_\_\_ tons of garbage to be recycled. Take the number of garbage that could be recycled and multiply it by $10 to find out how much money the city would make by recycling half its garbage each month. \_\_\_\_\_\_ tons of garbage / 50% = \_\_\_\_\_\_ tons x $10 per ton = \_$\_\_\_\_\_\_\_\_\_\_\_ per month. Take the number the city would have to pay for their garbage without recycling and divide it in half. That is what they would pay for their garbage if they did recycle. \_\_\_\_\_\_\_\_\_ dollars per month for garbage disposal / 50%. Now subtract the money that the city will earn by recycling from the amount the city will have to pay to get rid of its garbage. This is total cost of garbage disposal to the city, if the city recycles. Compare this number to the original cost of garbage disposal. Is recycling cost effective to a community?

Worksheet #4 Garbage Graph

Lesson Three: We Recycle!

Garbage Graph

Your collection area \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

About how much does your bag weigh? \_\_\_\_\_\_\_\_\_\_\_\_

Use the chart below to graph the garbage you collected. Fill the column with color up to the number of items you collected, to make a bar graph.

Organic (Food) Paper Plastic Glass Metal

20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1

List some of the individual types of garbage that you found in your Collection Area in the space below.

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